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Hypertension-related dietary patterns of rural older adults

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Abstract

Background. Prevalence of hypertension is greater in older adults, and increased intake of fruits, vegetables, and dairy—good sources of potassium, calcium, and magnesium—can reduce blood pressure. This study examined the hypertension-related dietary patterns of older adults.

Methods. A cohort of 180 Pennsylvania adults (aged ≥65), 90 with hypertension, were randomly selected from the Geisinger Rural Aging Study (GRAS). Data were collected by trained interviewers at a home visit. Dietary assessment used five 24-h recalls. We compared the characteristics and dietary intake of people with hypertension to those without hypertension and compared their intakes to current recommendations.

Results. Mean intakes of all participants were less than two thirds of the DRI for calcium and magnesium and fell far short of the 3,500 mg of potassium recommended for prevention and treatment of hypertension. Participants with hypertension consumed less sodium than controls. Both groups ate fewer fruits and vegetables than recommended but reached the dairy recommendation. Calcium intake was mainly from high-fat dairy products, beans were the top source of potassium and magnesium.

Conclusions. Older adults with hypertension should be guided to choose more low-fat dairy products and other low-fat calcium sources and to increase intakes of beans, dark green leafy vegetables, and other potassium and magnesium sources.

Keywords: Aged; Older adults; Hypertension; Diet

Introduction

More than 60% of adults 60 years and older have elevated blood pressure [1]. The risk of renal failure and cardiovascular events increase significantly in the presence of hypertension. Even high normal blood pressure (130/85 mm Hg) is associated with increased cardiovascular disease risk [2]. Consequently, an objective of Healthy People 2010 is to reduce the proportion of adults who have high blood pressure and increase the proportion of those with hypertension who are taking action to help control their blood pressure [3].

According to the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7), lifestyle modification is a key element of hypertension prevention and treatment [4]. To date, most dietary lifestyle therapies concentrate on sodium reduction and weight loss or maintenance [5]; however, a number of studies report that individuals with diets higher in calcium, potassium, and magnesium and foods that are good sources of these nutrients tend to have lower blood pressure readings than those with diets that are limited in these minerals [6–8]. Recently, the Dietary Approaches to Stop Hypertension (DASH) clinical trials demonstrated that both systolic and diastolic blood pressures could be significantly lowered with a low-fat, low-sodium diet rich in fruits, vegetables, and low-fat dairy foods [9–11]. The DASH dietary pattern is consistent with the Dietary

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Guidelines for Americans [12] and is recommended by organizations including the American Heart Association [13]. Higher intakes of fruits, vegetables, and dairy products are also associated with reduced risk of conditions including insulin resistance and certain cancers [14,15].

To provide dietary guidance to older adults to improve hypertension management, it is essential to understand and build on existing dietary patterns. Rural older adults have been noted as particularly vulnerable to dietary inadequacies including low intakes of calcium and magnesium [16,17]. However, we know little about the extent to which diets of older rural persons with hypertension conform to current recommendations. To that end, the purpose of this study was to assess current dietary patterns of older adults with hypertension selected from a sample of rural elderly persons, compare them with the patterns of older adults without hypertension, and describe their specific hypertension-related food group patterns. This study also compares the nutrient and food group intakes of the sample to current recommendations.

Methods

Participants for this study were a subset of the Geisinger Rural Aging Study (GRAS), a nutrition risk screening study of rural older adults [18]. The participants were all White. All GRAS participants were enrolled in a Medicare risk program administered through a not-for-profit health maintenance organization. Details of the study have been reported elsewhere [17]. Two hundred persons were randomly selected for intensive nutrition assessment from the larger GRAS cohort; 180 completed all five 24-h recalls and were included in these analyses. Of the 20 who did not complete the recalls, 1 was excluded due to poor cognitive function, 6 for depression, 11 withdrew, 1 died, and 1 had no data for hypertension status. This subset did not differ significantly from the larger GRAS cohort in demographic or anthropometric characteristics and serum albumin and cholesterol. Participants in this subset were less likely to have a poor appetite or to need assistance with bathing, traveling, and food preparation compared with those in the larger cohort, but these differences were quite small.

Ninety participants had hypertension, which was defined a priori as self-report of hypertension and current use of at least one antihypertensive medication [19]. Everyone who reported having hypertension was also taking antihypertensive medications. These data were obtained during a baseline assessment conducted by trained interviewers at a home visit. Participants were asked to present all medications they used at the time of the visit. Body mass index [BMI, weight (kg) / height (m^2)] was calculated from dietitian-measured height and weight. Demographic information and disease states were self-reported. Participants were classified as having cardiovascular disease if they reported having been told by a physician that they had angina, arrhythmia, congestive heart failure, coronary artery disease, a previous myocardial infarction, or other cardiovascular problems. Additional medical and demographic information were collected during the home visit. This project was approved by the Office for Regulatory Compliance at the Pennsylvania State University and the Institutional Regulatory Review Board of the Geisinger Health System.

Dietary Intake

Food and nutrient intake were measured using five 24-h recalls conducted by telephone over the year following the home visit. Recalls were conducted by trained staff at the Pennsylvania State Diet Assessment Center using the computer-assisted Nutrition Data System (NDS) (Version 2.6, Nutrient database version 12, food database 27. Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN. Release data 1996). Interviewers called participants to conduct a dietary recall every other month for 10 months following the home visit. Home visits and recalls were staggered throughout the year to reduce seasonal bias. Food portion posters (2D Food Portion Visual, Nutrition Consulting Enterprises, Framingham, MA) were used as a visual aid for estimating amounts of foods eaten. Nutrient data were averaged across 5 days to obtain energy, fat, calcium, magnesium, potassium, and sodium intakes. NDS summary file data containing each food consumed were edited to analyze for food groups allowing the identification of specific food [20]. The contribution of each food subgroup was calculated for each nutrient for participants with hypertension.

Statistical analyses

Statistical analyses were conducted using SAS version 8 (SAS Institute, Cary, NC). Differences in dietary intake between the older adults with hypertension and the control group were compared by *t* tests. Differences between groups in demographic and health-related characteristics were examined using chi-squared analyses. A P value of 0.05 or less was considered significant.

Results

All participants (N = 180, 90 with hypertension and 90 controls) were non-Hispanic Whites. Demographic data are shown in Table 1. Both groups had a mean age of approximately 73 years, and 44% of both groups were male. More than three quarters had at least a high-school degree (76.7% of controls, 82.2% of those with hypertension) and most were married (73.3% of controls, 72.2% of those with hypertension). Participants with hypertension were more likely than controls to report having some form of cardiovascular disease (46.7% vs. 32.2%, P = 0.047). There was no significant difference between groups in prevalence of high serum lipids or triacylglycerol, non-insulin-dependent

Table 1
Demographic and health characteristics by hypertension status

	No hypertension (n = 90)	Hypertension (n = 90)	P
n (%)			
Sex (male)	40 (44.4)	40 (44.4)	1.00
Education			0.615
Less than high-school graduate	21 (23.3)	16 (17.8)	
High-school graduate	43 (47.8)	44 (48.9)	
Education beyond high school	26 (28.9)	30 (33.3)	
Married	66 (73.3)	65 (72.2)	0.867
Cardiovascular disease	29 (32.2)	42 (46.7)	0.047
High serum cholesterol or triacylglycerol	38 (42.2)	43 (47.8)	0.454
Non-insulin-dependent diabetes	8 (8.9)	15 (16.7)	0.118
Gastrointestinal disease	22 (24.4)	19 (21.1)	0.594
Liver disease	15 (16.7)	24 (26.7)	0.104
Kidney disease	6 (6.7)	10 (11.1)	0.295
Osteoporosis	7 (7.8)	12 (13.3)	0.225
On a special diet	23 (25.8)	45 (50.0)	<0.001
Mean ± SD			
Age (years)	73.4 ± 4.9	73.4 ± 5.0	0.991
Body mass index (kg/m^2)	27.6 ± 3.7	29.8 ± 5.8	0.002
Number of medications	1.7 ± 2.4	3.8 ± 2.5	<0.001

diabetes mellitus, gastrointestinal disease, liver disease, kidney disease, or osteoporosis. The hypertension group was also more likely to report being on a special diet (50.0% vs. 25.8%, $P < 0.001$) and had a higher BMI ($P = 0.002$). Those in the hypertension group also took more medications than controls ($P < 0.001$).

Table 2 shows the mean energy, nutrient, and food group intakes of the hypertension and control groups. Controls reported consuming more energy ($P = 0.011$), but both groups got about 31% of their energy from fat and 11% of their energy from saturated fat. Intake of calcium, magnesium, and potassium were similar, but the hypertension group consumed less sodium ($P = 0.003$).

There was no difference between groups in the mean daily number of servings of fruits, vegetables, dairy foods, or fats, oils, or sweets. Participants ate 1.8 servings of fruit, 2.6 servings of vegetables, about 2 servings of dairy foods, and more than 5 servings of fats, oils, or sweets (Table 2). However, the control group ate more servings of grains and meats than those with hypertension (P's = 0.006 and 0.037, respectively).

Table 3 shows food subgroups for participants with hypertension only, the percent of people who ate foods in each subgroup (i.e., users) and the mean amount of fat and minerals of interest that each subgroup contributed to the diet per day. A food that has less than 3 g of fat per serving is considered to be low in fat and foods with fewer than 140 mg sodium are considered to be low in sodium [21]. The food subgroups that contributed to the intake of the nutrients of interest were similar for the hypertension and control groups. Because the objective of this paper is to review the diets of people with hypertension to provide more specific guidance, Table 3 only reports the food subgroup data for the hypertension group.

Fruits

About two thirds of the participants ate citrus, melons, and berries (65%) as well as fruit juices (71%). Citrus, melons, and berries contributed 283 mg potassium to the diet of users of these foods. Fruit juices—the greatest source of calcium after dairy foods—provided 90.7 mg of calcium and also contributed 317 mg potassium. Almost all participants ate "other fruits" (94%), most of which were bananas. These other fruits were the third greatest source of potassium (394 mg).

Vegetables

Most participants (81%) ate dark green leafy and deep yellow vegetables such as broccoli, lettuce, and carrots. However, they only ate about three quarters of a serving. As a result, this subgroup was not a major source of any of the minerals of interest. Almost everyone ate starchy vegetables, which were mainly potatoes but also included corn and peas. Starchy vegetables were the second greatest contributor of potassium (435 mg) and were the fifth greatest contributor of magnesium to the diet (31 mg). Everyone ate "other vegetables," which included string beans, tomatoes, onions, and beets. Tomato sauce was the most common food in the "vegetable sauces and juices" category. This category was eaten by 70% of participants and provided a good source of potassium (329 mg). However, it was also a significant contributor of sodium in the diet (476 mg).

Dairy products

Most of the calcium in the diet came from dairy products—milk (269 mg), yogurt (240 mg), and cheese (184 mg). Everyone drank milk and most ate cheese (87%), but

Table 2
Dietary intake of selected nutrients and food groups (Mean ± SD) for participants with and without hypertension

Dietary variables	No hypertension	Hypertension	P
Energy (kcal)	1686 ± 487	1500 ± 481	0.011
% kcal from fat	31.3 ± 6.4	31.0 ± 7.0	0.759
% kcal from saturated fat	11.0 ± 3.0	10.7 ± 3.3	0.525
Nutrients (mg)			
Calcium	629 ± 298	664 ± 263	0.492
Magnesium	258 ± 85	241 ± 82	0.184
Potassium	2541 ± 726	2443 ± 722	0.367
Sodium	2962 ± 969	2540 ± 938	0.003
Food groups (servings)			
Fruits	1.8 ± 1.0	1.8 ± 1.4	0.924
Vegetables	2.6 ± 1.0	2.6 ± 1.1	0.728
Dairy	2.1 ± 1.5	1.9 ± 1.1	0.361
Grains	5.9 ± 1.8	5.0 ± 2.1	0.006
Meat	2.0 ± 0.9	1.8 ± 0.8	0.037
Fats, oils, and sweets	5.7 ± 3.4	5.1 ± 3.3	0.249

Table 3
Food group intake for participants with hypertension (n = 90): mean number of servings and fat and mineral content

Food groups	Percentage of users	Intake by users						
		Servings	Fat (g)	Fat (g)/ serving	Ca (mg)	Mg (mg)	Na (mg)	K (mg)
Fruits								
Other fruits	94	1.5	0.7	0.5	13.7	24.9	4.3	394.2
Fruit juices	71	1.0	0.2	0.2	90.7	19.1	3.6	316.6
Citrus, melon, and berries	65	1.3	0.3	0.2	32.9	15.2	3.2	283.0
Vegetables								
Other vegetables	100	1.2	0.4	0.3	22.2	12.7	132.5	185.5
Starchy vegetables	96	1.6	1.9	1.2	12.9	30.8	81.0	434.6
Dark green leafy and deep yellow	81	0.8	0.2	0.2	26.7	12.4	34.6	180.6
Vegetable sauces and juices	70	0.9	1.4	1.6	27.9	18.0	476.5	328.7
Dairy								
Milk	100	1.2	4.9	3.9	269.3	29.9	218.7	349.5
Cheese	87	0.7	8.4	11.9	184.2	8.6	340.7	56.1
Dairy desserts	67	1.4	7.9	5.7	133.0	16.4	125.7	192.5
Yogurt	10	0.7	1.4	2.0	239.5	24.3	91.1	336.3
Animal foods								
Beef, pork, and lamb	95	1.0	11.1	11.5	6.8	19.6	288.0	304.9
Processed meats	76	0.9	9.4	10.1	9.0	6.7	559.3	120.9
Eggs	75	0.9	4.6	5.1	21.8	4.6	68.6	57.8
Poultry	74	0.7	5.0	6.8	11.0	16.0	140.9	153.9
Fish and seafood	42	1.1	5.0	4.6	69.9	42.6	301.8	307.8
Other protein sources								
Nuts and seeds	44	0.5	9.1	17.4	11.6	31.2	64.1	124.9
Beans	32	1.4	2.1	1.5	74.4	67.7	338.0	577.5
Meat substitutes	7	0.8	2.0	2.6	62.2	16.2	82.5	80.6
Grains								
Breads	100	2.8	2.9	1.0	68.2	24.0	382.7	105.4
Cereals	86	1.3	1.7	1.3	67.4	46.6	216.1	158.8
Pasta, noodles, and rice	79	1.4	0.9	0.6	12.2	17.7	111.1	38.8
Sweet breads, pastries, and desserts	79	1.5	11.4	7.4	26.6	11.9	186.0	74.7
Pancakes, waffles, and French toast	19	2.5	4.7	1.9	82.9	13.0	567.6	86.3
Other								
Fats and oils	99	4.2	14.7	3.5	12.5	1.9	189.5	29.7
Sweets	98	2.9	1.6	0.5	19.9	9.8	66.0	77.9
Snack foods	74	1.3	3.9	3.0	13.0	12.0	246.6	41.6

Subgroups are listed in order of percent users in each food group.

only 10% ate yogurt. Milk and yogurt were also good sources of magnesium (30 and 24 mg, respectively) and potassium (350 and 336 mg, respectively), but the milk consumed had about 4 g of fat per serving. The cheese was also high in saturated fat (8 g) and was one of the major contributors to sodium in the diet (341 mg). Dairy desserts—mostly ice cream—were the fourth best source of calcium in the diet but had an average of almost 6 g of fat per serving.

Animal products

The fish and seafood category, which was eaten by less than half of the participants (42%), was one of the top sources of magnesium (43 mg) and also contributed 308 mg potassium to the diet. However, these foods had more than 4 g of fat and 302 mg sodium per serving. Beef, pork, and lamb, which were eaten by almost all participants (95%), provided about 300 mg potassium and also 288 mg sodium. Most people (76%) averaged about one serving of processed meat per day, which provided more than 500 mg sodium.

Other protein sources

Beans contributed the most magnesium (68 mg) and potassium (577 mg) to the diets of participants who ate them and also had 74 mg of calcium. However, most of the beans consumed by participants were baked beans; they were low in fat (2 g) but high in sodium (338 mg). The half

serving of nuts and seeds that were eaten by almost half of the participants were a good source of magnesium (43 mg).

Grains

All participants ate breads and most ate cereals (86%). Both categories were low in fat (3 and 1.7 g, respectively), but breads had close to 400 mg of sodium. Pancakes, waffles, and French toast were eaten by only 19% of participants but had the greatest amount of sodium of any subgroup (567.6 mg).

Discussion

The purpose of this study was to assess mineral and food group intakes of older adults with and without hypertension relative to current recommendations. The nutrient and food group intakes of the two groups were similar, except that those with hypertension ate less sodium and fewer grain and meat servings. Although the dietary patterns of participants with hypertension were similar to those without the condition, it is important to note that with the exception of sodium, they were not meeting the recommendations for intake of key nutrients and food groups recommended for the treatment of hypertension.

In general, mineral intakes (i.e., calcium, magnesium, and potassium) mirrored national survey data for adults 60 years and older [22,23]. The exception was sodium intake among those with hypertension, which was somewhat lower than national data. This could be the result of the wide dissemination of the sodium and hypertension message [4,12]. Indeed, national data show that more than half of U.S. adults with hypertension have been told by a health professional to reduce salt intake [24].

Although the sodium intake of participants with hypertension was close to the recommendation of no more than 2,400 mg, participants may benefit from a further reduction of dietary sodium. Those without hypertension consumed close to 3,000 mg sodium and should also be encouraged to reduce their intake. For most people, much of the excess sodium came from processed meats and vegetable sauces and juices. Therefore, avoiding processed meats and choosing lower sodium sauces and vegetable juices would help lower sodium intake further.

Intake of the other minerals was considerably below recommendations. Calcium intakes were about half the recommended level. As expected, dairy foods were the best source of calcium; however, participants mainly chose high-fat dairy foods. Monitoring fat intake, particularly saturated fat intake, is especially important in this population because of the high prevalence of heart disease and diabetes. Encouraging substitution of low-fat dairy foods for the whole fat milk and cheese they currently eat and increasing dairy intake by one to two servings may be an effective way to increase calcium intake in this population. Since only 10% of participants eat yogurt, it may not be reasonable to expect many people to add it to their diets. Fruit juices were also an important source of calcium, indicating that calcium fortification of juice can positively affect calcium intake [25]. Therefore, adding a serving of calcium-fortified juice may also be a feasible way to increase calcium intake.

Magnesium intakes were also below recommended levels. Beans, nuts and seeds, cereals, and fish and seafood were the best sources of magnesium in the diet. However, it is important to note that with the exception of cereals, fewer than half the participants ate these foods. Beans, nuts, and seeds are also important components of the DASH diet [26]. Beans add fiber to the diet as well as magnesium; nuts have been found to reduce serum lipid levels and risk for cardiovascular disease [27,28]. The beans eaten by this population were mostly baked beans and they were only eaten by about one third of the participants. A lot of the fish and seafood eaten were canned tuna and salmon, but participants also prepared some fresh and frozen fish. In addition to the above foods, dark green leafy vegetables are good sources of magnesium. Increasing consumption of those vegetables would also increase magnesium intake.

Potassium intakes were consistent with the current recommendation of 2,000 mg [29]. However, JNC VI recommends a daily intake of 3,500 mg of potassium per day for preventing and treating hypertension [19], and participants were considerably below this level. In addition, many adults with hypertension are advised to increase their intake of potassium-containing foods to offset the effects of potassium-depleting diuretics. Indeed, many participants regularly ate bananas and drank citrus juices, two foods often recommended for diuretic users. Other main sources of potassium in the diet were starchy vegetables, such as potatoes, and milk. Participants could increase potassium intake not only by drinking more milk and fruit juices but also by increasing intake of dark green leafy, deep yellow, and other vegetables, lower sodium vegetable sauces and juices, and more fruits.

Participants in this study consumed fewer servings of fruits and vegetables and more dairy servings than non-Hispanic Whites 60 years and older participating in a national survey [23]. The Food Guide Pyramid (FGP) recommends two to three servings of fruit and three to five servings of vegetables each day [30]; the DASH dietary pattern includes four to five servings of fruit and four to five servings of vegetables each day [31]. Neither group met the FGP recommendations for fruits and vegetables and were well below the DASH standard for those food groups. Both the FGP and DASH recommend two to three servings of dairy foods per day. Participants with and without hypertension approximately reached two servings but would benefit from increased dairy intake, as mentioned above. The DASH diet specifically recommends low-fat dairy foods and a diet that has less than 27% of energy as fat. Neither group met this recommendation or that of the Dietary Guidelines (less than 30% of energy as fat) [12]. The greatest sources of fat in the diet were dairy foods and meats. Fat intake above the

national guidelines may contribute to the high prevalence of overweight and obesity in this population. Increasing fruit and vegetable intake and substituting low-fat dairy foods and lean meats for high-fat dairy and meats may help reduce the prevalence of overweight.

It is not surprising that many participants were not meeting the DASH guidelines since the outcomes of the study have only recently been published in professional journals [9–11] and lay magazines. However, on average, participants did not meet even the more established FGP guidelines. Increasing Americans' consumption of fruits and vegetables is a national health priority [3]. Diets rich in fruits and vegetables are beneficial not only in hypertension management but also in reducing risk for various age-related diseases including heart and vascular diseases [32], some cancers [33], eye diseases [34], and loss of bone mineral density [35]. Similarly, dairy products are promoted as a rich source of nutrients that reduce risk of bone mass loss and colon cancer [36] and may play a role in weight loss and maintenance [37].

To design more effective interventions, future research should explore why older adults do not meet recommended intakes of fruits, vegetables, and dairy foods. A number of factors could contribute to these less than desirable dietary patterns including pricing of food, availability of food in the local area, potential for storage and spoilage, oral health problems, and other concerns. In addition, commonly used medications and combinations of medications may alter appetite, taste preferences, swallowing, dry mouth, and other factors that could influence dietary patterns [38].

Limitations of this study include the lack of measurement of blood pressure. Therefore, it was not possible to assess any relationship between diet and blood pressure, and participants who were not aware they had high blood pressure might have been misclassified and placed in the control group. However, the prevalence of hypertension in this sample was similar to the prevalence in the older U.S. population [1]. Also, it is not possible to determine whether the blood pressure of the participants with hypertension was in control or whether diet differed based on control. Even so, dietary change is beneficial in people with controlled and uncontrolled hypertension. Whelton et al. [39] found that reducing sodium intake lowered blood pressure even in patients with controlled hypertension. It is also important to note that the dietary assessment did not ask about the salt added at the table so we may have underestimated sodium. Finally, underreporting is common in dietary data and has been reported in a subset of GRAS participants [40]. However, we are not able to estimate the impact of underreporting or its effect on the food groups and nutrients of interest in this study.

The objective of the Surgeon General's Healthy People goals is to improve blood pressure control and to increase the proportion of Americans who are taking action to control their blood pressure [3]. Diet is critical for blood pressure management. In this paper, we have proposed a number of changes in food intake that could result in a more prudent, heart-healthy diet for the older adults with hypertension in this study. The recommendations include add a serving of dairy products to your diet each day; avoid processed meats to decrease sodium intake; choose lower sodium vegetable sauces and juices; substitute low-fat dairy foods for whole milk products; add calcium-fortified juices to your diet; and increase dark green leafy vegetables. Many of these recommendations are consistent with strategies used by older adults to decrease fat intake [41] and generally similar to strategies for dietary change proposed by Kristal et al. [42,43] including food substitutions, replacements, and exclusions. Suggesting dietary changes that fit into the existing dietary patterns of rural older adults may result in more long-term change.

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